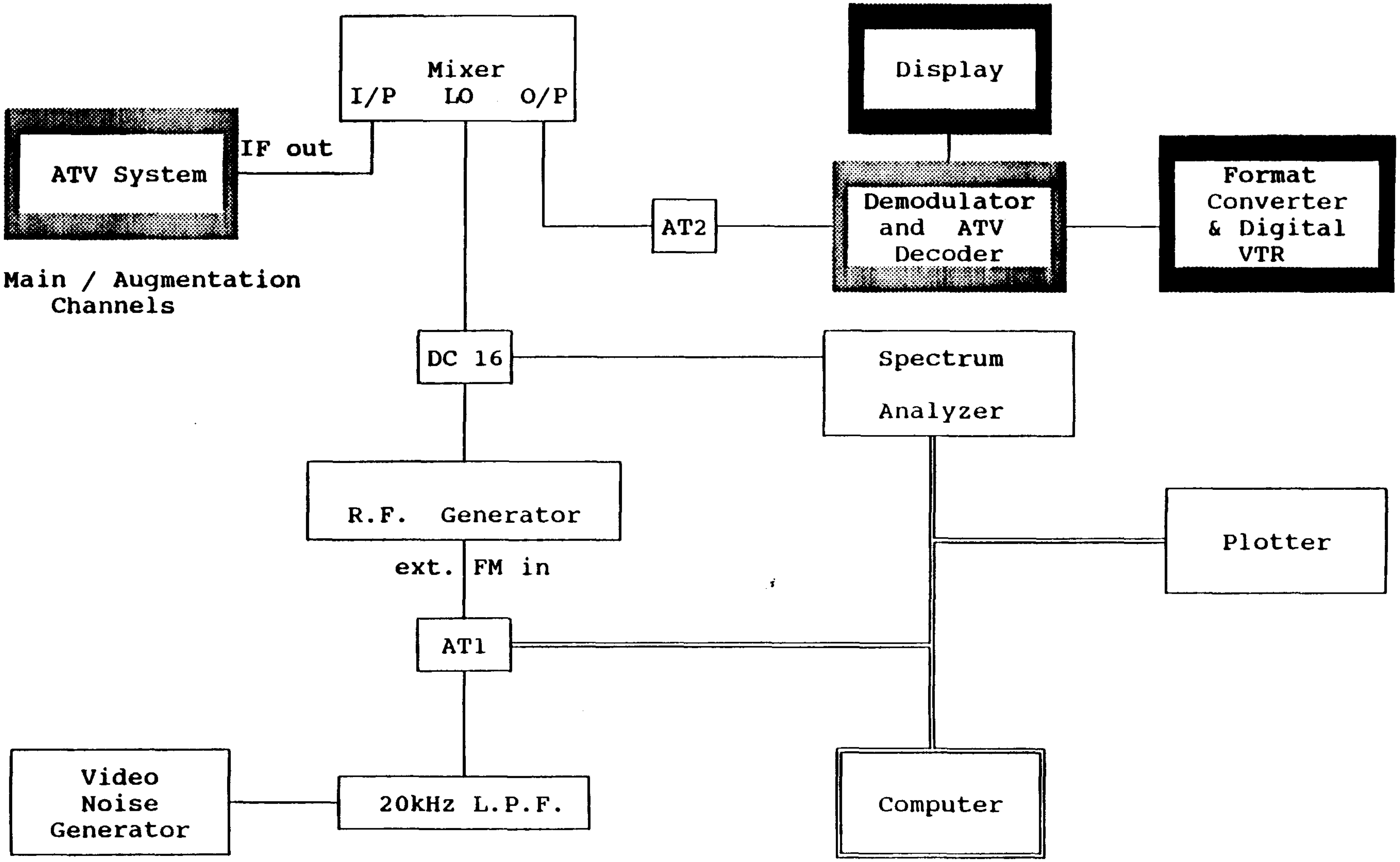

Figure 7.1 Incidental Carrier Phase Modulation Equipment Setup Block Diagram.

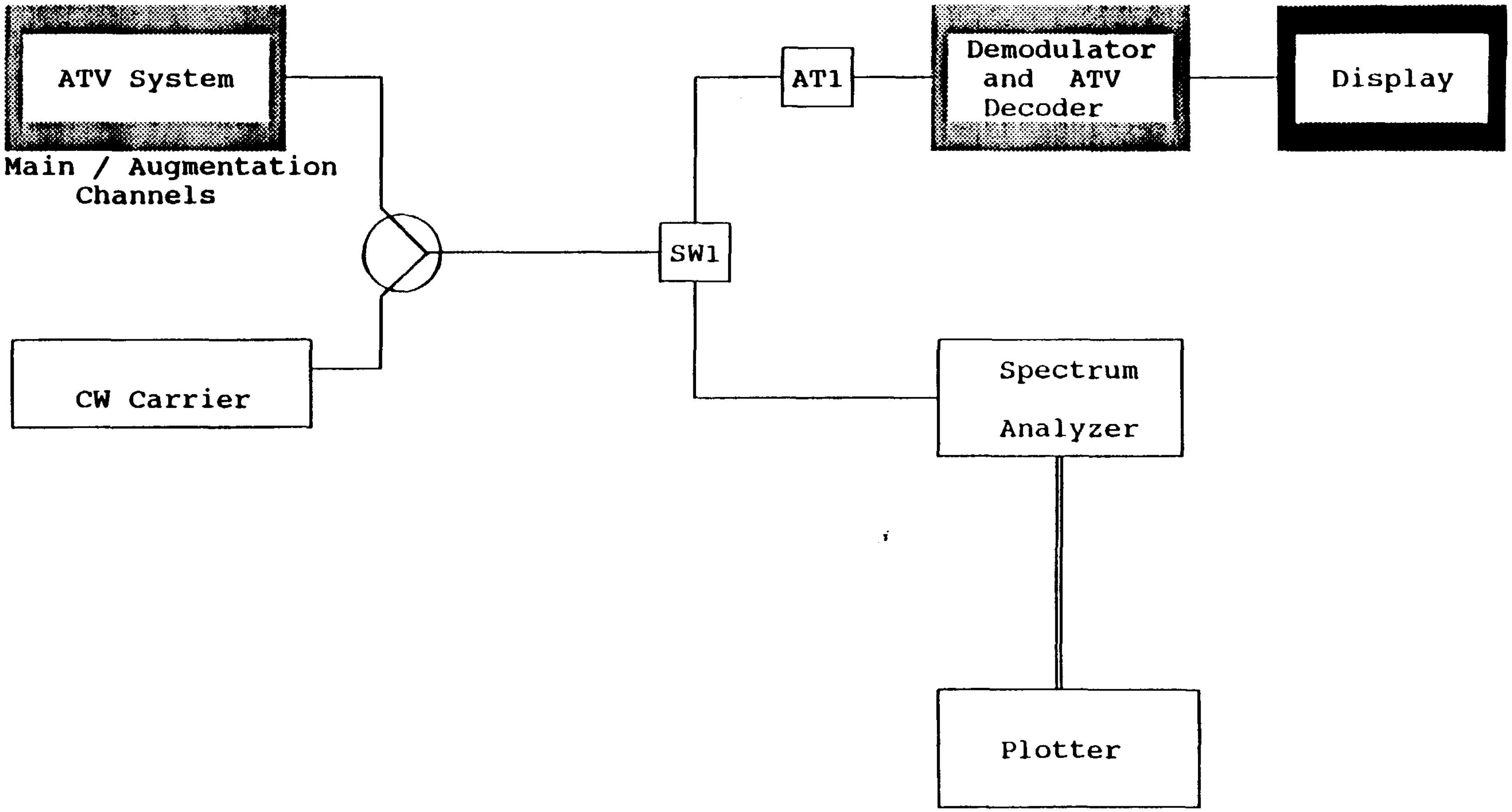

Figure 8.1 Peak Power Measurement Equipment Setup Block Diagram.

SSWP2-0189
Rev 16 Feb 90

ATV Test Procedures Manual

Objective and Transmission Tests

1. Image Resolution

1.1 Introduction

One of the major characteristics of a television system affecting overall picture quality is the ability of the system to reproduce fine detail found in the original image. This ability to resolve detail is determined by a number of factors, such as the number of scanning lines employed, the frame repetition rate, and the overall response of the signal processing circuitry. In conventional television systems, the first two factors are dominant due to the high level of refinement of state-of-the-art signal processing techniques. However, in comparing advanced television (ATV) systems intended for terrestrial broadcasting, the signal processing utilized to achieve spectrum compatibility is a major variable among the proposed systems.

Picture detail must be regarded in a three-dimensional context that includes spatial and temporal components. Spatial details may be analyzed along horizontal, vertical, and diagonal axes of the image. Furthermore, brightness (luminance) details must be considered separately from details associated with color differences (chrominance). It is well known that human visual response varies among all of these components. Alternative approaches to increasing the performance of television systems choose different trade-offs among the components in order to maximize the subjective reproduction of fine detail within the constraint of spectrum conservation.

The objective test procedures described in this document address each of the factors discussed above on an individual basis. How well a given system accomplishes the trade-offs among them is a subjective evaluation that must be undertaken separately from these objective tests. In order to facilitate the subjective tests, the results of each procedure are recorded on digital video tape and a log is maintained of the location on tape of each test.

1.1.1 Definitions

Resolution is a measure of ability to delineate picture detail.

Static Resolution measures ability to reproduce stationary, time-invariant, detail. It is important to note that, while some picture sources such as electronic graphics generators, still stores, and slide scanners can produce stationary details, most television pictures exhibit motion. Even a live camera viewing a stationary scene produces minute movement of details due to such factors as vibration.

Dynamic Resolution measures the ability of a system to preserve image detail during movement. Loss of dynamic resolution appears as blurring or even absence of moving details. This parameter is closely related to integration time, which may be thought of in still photography terms as the length of time the shutter is open to capture a snapshot of the scene. Longer integration time results in more blurring. Solid-state video cameras, with electronic shutters, are capable of very short integration times and high dynamic resolution. However, the signal processing employed in some ATV transmission systems may sacrifice dynamic resolution for improved static resolution.

Temporal Resolution is a measure of ability to portray accurately events that occur only briefly or that are closely spaced in time. It is determined by the temporal sampling rate. When the rate of motion of image details exceeds the Nyquist limit of this temporal sampling, aliasing appears as incorrect velocity of the moving details. A well-known example of this effect is the apparently backward-turning wagon wheels seen in western movies.

It is important that any technique for "objective" measurement of dynamic resolution, by observation of a displayed image, not cause temporal aliasing, since aliasing will confuse interpretation of the results. Assessment of temporal resolution; i.e., aliasing or motion "judder," is properly a separate subjective exercise.

Limiting Resolution is a measure of resolution that is often expressed in terms of the maximum number of lines per picture height discriminated on a camera image of a printed test chart. For a given number of lines, N (alternate black and white lines), the width of each line is 1/N times the picture height. In the context of this document, resolution is expressed in terms of the maximum number of sinusoidal cycles per picture height (C/PH) that can be discriminated on the transmitted image of an electrically generated test pattern. Since either of these measurements depends upon discrimination by a human observer, the result is approximate. The procedures in this document utilize the consensus of a panel of expert observers, rather than a single observer.

Resolution Response is a more objective means of expressing resolution. It is the ratio of the peak-to-peak signal amplitude given by a test pattern at a specified spatial frequency (defined in cycles per picture height) to the amplitude at a specified low frequency. It is understood that these points of measurement are located on a curve of the modulation transfer function, or MTF.

Use of a sinusoidal test signal facilitates derivation of the modulation transfer function of the system by graphing resolution response measurements. It is well known that the manufacture of printed test charts having sinusoidal intensity variation is very difficult. However, an electronic test signal generator can produce such a pattern.

In those cases (e.g., horizontal resolution) in which measurement instrumentation (line-selecting waveform monitor) is readily available, resolution response will be measured to supplement the determination of limiting resolution by the panel of expert observers.

Luminance is the component of a video signal that conveys brightness information. A given transmission system may contain a separate channel for this component. Luminance may be derived by summing the Red, Green, and Blue signals in appropriate proportions. Since Green constitutes at least 59 percent, the luminance channel may be regarded as carrying predominantly Green information.

Chrominance is the component of a video signal that conveys color information. A typical transmission system contains two "color-difference" channels which, when matrixed appropriately with luminance, yield unique Red, Green, and Blue signals. Commonly used color-difference pairs are I, Q; and R-Y, B-Y. The I and Q signals may have unequal bandwidths; the R-Y and B-Y signals generally have equal bandwidths. The matrix equations that define the color difference signals in terms of Red, Green, and Blue may be different for an ATV system than for NTSC. Each proponent must furnish to ATTC the coefficients that apply to his system.

Note: A system may transmit RGB components, rather than luminance and two color-difference components. In this case, the system shall be tested as though it comprised three luminance channels.

Side Panels are those portions of a wide-screen ATV image that lie outside the area that can be transmitted by conventional NTSC standards. It is assumed in this document that, for those transmission systems employing side panels, the NTSC-compatible portion is centered within the wider ATV image and is of equal height. This centered position shall be established prior to testing NTSC-compatibility issues on systems that have "pan and scan" capability.

1.1.2 General Description of Method

The fundamental basis for making a measurement of resolution of a television system is to transmit a suitable test pattern through the system under test, and to observe the reproduced image on a picture monitor and the output electrical signal on a video waveform monitor. The test pattern must have a sufficient amount of fine detail such that a quantitative observation can be made of the amount of this detail that is reproduced. This is usually done by incorporating in the pattern a series of lines having graduated widths. The point in the reproduced picture where the separate lines are no longer visible gives a measure of the limiting resolution of the system. A measurement of the resolution response, for lower spatial frequencies, is obtained by using the Line Select feature of the waveform monitor to display those portions of the pattern that have the specified spatial frequencies.

Measurement of static resolution along horizontal, vertical, and diagonal axes of the image is facilitated by a test pattern known as a Radial Resolution Chart. One such chart, designed to be imaged by a camera, is shown in Figure __. On this chart, the width of the radial lines increases linearly with the distance outward from the center, and equally in all directions. Circles calibrate the chart in lines per picture height over a five-to-one range.

Dynamic resolution measurement may use a single-frequency sinusoidal pattern. For each axis tested, the orientation of the pattern is changed such that the sinusoidal amplitude variation is along the axis of motion. The variation in the amplitude of the reproduced pattern between static and dynamic conditions is a measure of the dynamic resolution of the system under test.

The specified interface between the systems under test and the test apparatus (Appendix --) does not provide access to the luminance and chrominance components. For the purpose of testing luminance performance, the appropriate test signal shall be applied equally to the Red, Green, and Blue inputs of the system under test. It shall be assumed that the performance observed at the Green output is representative of the luminance performance, and only this output shall be measured. Chrominance performance shall be tested by individually testing two color-difference components. For NTSC-compatibility tests, the output of a professional reference-quality NTSC demodulator shall be connected to the monitoring equipment, luminance and chrominance being extracted within that equipment as required.

1.2 Test and Measuring Equipment

1.2.1 Signal Sources

While it is useful to conceptualize the test procedure using a camera-imaged radial resolution chart, as described above, implementation is best accomplished with an electrically-generated test pattern. This permits realization of a truly stationary pattern for static resolution measurements.

One suitable signal source is the Zone Plate Generator, which is commercially available for conventional television standards and for some, but not all, of the proposed ATV systems. The tests described herein utilize the PIXAR Generator. It is customized for ATV system testing, and it permits the radial resolution pattern to be generated in each format.

The PIXAR pattern comprises sinusoids having a peak-to-peak amplitude of 420 millivolts and a pedestal level of 350 millivolts. The dynamic range occupied by the test signal is limited so that small-signal characteristics of the system under test (SUT) are evaluated, and any nonlinearities associated with the handling of full-amplitude, high-frequency signals are not excited. Also, spot blooming of the picture monitor near peak white is avoided.

For the gamut of resolution tests to be performed, several variations of the basic radial pattern, having different ranges of spatial frequencies, are required. These are detailed in the individual test procedures.

1.2.2 Monitoring

Since it is necessary to evaluate not only the end-to-end performance of the ATV system but the NTSC compatibility as well, separate ATV and NTSC monitoring setups are required. The expert panel must observe a high-resolution projection display. Objective measurements must be taken from a line-selecting waveform monitor in each standard. In addition, photographs from high-resolution picture monitors and the waveform monitors must be taken to document the measurements and to permit interpretation by others at a later time.

The setup procedures for calibration of the various monitors and projectors are detailed in Appendix --. The procedures for monitor photography are described in Appendix --.

1.2.2.1 Active Video Gate

Photography is facilitated by a specially-constructed apparatus, called the Active Video Gate, which is interposed between the video output of the system under test and the video input of the picture monitor. The gate is designed to keep the monitor at black except during a specified number of frame intervals following enabling of the gate by the operator. This action is synchronized by the sync signal of the system, so that whole frames are displayed. The resulting photographs are free of "shutter bar," and an exact number of frames of the picture are equally captured in every case. While a one-frame exposure is correct for NTSC pictures, some ATV systems require multiple-frame photographs.

The gate is designed to pass all signals during blanking intervals, so the DC restorer in the monitor operates normally and black level is maintained. The passing of active video is inhibited until it is manually enabled by the operator. Hence, until the apparatus is enabled, the monitor is at black level, synchronized and ready to display a picture. The photography must take place in a completely dark room. The operator selects the desired number of frames, opens the camera shutter, and then enables the active video gate. At the next vertical sync interval, the gate allows active video to pass through to the monitor. A counter in the apparatus keeps track of the number of frames captured and again inhibits the passing of video after the desired number. The operator can then close the camera shutter.

The active video gate has a bypass mode, so that it can remain connected for normal viewing.

1.2.2.2 ATV Monitoring

The picture monitor shall be a monochrome monitor capable of scan rates from 31 - 48 kHz and having a bandwidth of at least 30 MHz. The spot size shall be such that the monitor resolution exceeds that of any ATV system to be evaluated by ATTC. The H-delay or pulse cross feature is highly desirable.

The waveform monitor shall have a vertical amplifier bandwidth and transient response such as to introduce negligible display errors at any frequency up to at least 30 MHz. It shall be fitted with a line selector, which will permit the selection, display, and identification of any desired horizontal scan interval once each frame time.

1.2.2.3 NTSC Monitoring

For those systems claiming NTSC compatibility, the compatible RF signal will be applied to a professional, reference-quality NTSC demodulator. Measurements will be made on the baseband NTSC video output from this demodulator.

Picture monitor specification to be determined. A "Blue Only" mode will aid in observation of the low-luminance signal that results when only the Blue input of the SUT is excited.

Waveform monitor specification to be determined. Use of an automatic video monitoring and measuring instrument will facilitate standard NTSC measurements. Such an instrument may also provide a hard-copy output of the display, obviating the need for manual photography of the waveform.

A choice of two types of chrominance filtering must be available in both the waveform monitor and the picture monitor. This may require the use of separate instruments for each type of filter. For horizontal measurements, a comb filter is required for the widest possible horizontal bandwidth. For vertical and diagonal measurements, a band-pass filter must be used to avoid comb-filter artifacts.

1.3 Procedures

All of the following procedures involve the determination of limiting resolution. This determination will be based upon the consensus of a panel of at least four expert observers, viewing either a high-resolution direct-view monitor or a high-resolution rear projection display, or both. In some cases, it may be necessary for the panel to make its determination from photographs of a direct-view monitor display. In addition, the horizontal resolution procedures include measurement of resolution response using laboratory instrumentation.

Procedures for calibrating the monitors, prior to making any measurements, are described in Appendix --.

Procedures for monitor photography are described in Appendix --.

1.3.1 Luminance Static Horizontal Resolution - ATV System

1.3.1.1 Setup

Connect the output of the PIXAR to the Red, Green, and Blue inputs of the SUT. Use a wideband video distribution amplifier driving equal lengths of identical coaxial cable into 75-ohm terminations at the encoder input.

Connect the Green output of the SUT to the waveform monitor. Connect the "picture monitor output" of the waveform monitor, through the active video gate, to the picture monitor. Terminate each cable in 75 ohms.

Select PIXAR Test Pattern No. 1. It contains a radial resolution pattern, calibrated from 100 to 500 C/PH in the center NTSC compatible image area, continuing into each side panel area.

1.3.1.2 Measurement Technique

1.3.1.2.1 Center Area

Observe the picture monitor, and discern the limiting horizontal resolution. Look up and down along a vertical axis through the center of the pattern, and note the points above and below the center at which the individual radials emerge from the gray background. Using the calibration circles, estimate the spatial frequency, in C/PH, at which the radials become visible.

Using the line selector of the waveform monitor, move the cursor so that it is tangent to a point of limiting resolution noted above. The amplitude of the observed sinusoidal waveform should diminish to nearly zero at the center of this line.

Note the peak-to-peak amplitude of the radial resolution pattern, in the lowest-frequency portion of the pattern. This is the reference amplitude for the resolution response measurement.

Move the line selector toward the top or bottom of the pattern to find the line corresponding to the half-amplitude resolution response. At the center of the correct line, the amplitude of the sinusoid should be one-half of the reference amplitude noted above. Observe the position of the line-select cursor overlaid on the picture display. Using the calibration circles, estimate the spatial frequency, in C/PH, at which the cursor intersects the vertical center axis of the pattern.

1.3.1.2.2 Side Panels

Perform the following procedure if the proponent system includes transmission of side panel information in a manner different from transmission of picture center information.

Observe the picture monitor, and discern the limiting horizontal resolution of the side panels. Shift the PIXAR pattern horizontally so that the center of the pattern is in the center of the side-panel area, the leftmost or rightmost one-eighth of the picture width. If the picture monitor is so equipped, use the H Delay or Pulse Cross mode to position the side panel of the image in the center of the display. This will eliminate any side-to-center resolution difference in the monitor as a factor in the measurement. Look up and down along a vertical axis through the center of the pattern, and note the points at which the individual radials emerge from the gray background. Using the calibration circles, estimate the spatial frequency, in C/PH, at which the radials become visible.

Using the line selector of the waveform monitor, move the cursor so that it is tangent to a point of limiting resolution noted above. The amplitude of the observed sinusoidal waveform in the side panel should diminish to nearly zero on this line.

Move the line selector toward the top or bottom of the pattern to find the line corresponding to the half-amplitude resolution response of the side panels. On the correct line, the amplitude of the sinusoid should diminish to one-half of the reference amplitude established in the procedure for the center area. Observe the position of the line-select cursor overlaid on the picture display. Using the calibration circles, estimate the spatial frequency, in C/PH, at which the cursor intersects the vertical center axis of the wedges.

Upon completion of this procedure, return the test pattern to the centered position.

1.3.1.3 Presentation of Data

The following data should be recorded:

From the picture monitor, the limiting horizontal resolution of the center area, and of the side panels, in C/PH.

From the waveform monitor, the half-amplitude resolution response of the center area, and of the side panels, in C/PH.

For reference purposes, record the selected line numbers on which the limiting resolution, reference amplitude, and half amplitude, for the center area and the side panels, were observed on the waveform monitor.

Photograph the picture monitor, using a video gate time of one frame. Also photograph the waveform monitor displays of the selected lines.

Make a 15-second recording on the HD DVTR, and note the SMPTE time code at the start of the recording.

1.3.2 Luminance Static Vertical Resolution - ATV System

1.3.2.1 Setup

The setup described above, in Section 1.3.1.1, can remain in place for this measurement, although the waveform monitor is not used.

1.3.2.2 Measurement Technique

1.3.2.2.1 Center Area

Observe the picture monitor, and discern the limiting vertical resolution. Look side to side along a horizontal axis through the center of the pattern, and note the points left and right of the center at which the individual radials emerge from the gray background. Using the calibration circles, estimate the spatial frequency, in C/PH, at which the radials become visible.

Spurious patterns, or aliasing, may be observed due to beats between the scanning lines and the test pattern. If aliasing obscures the point of limiting resolution, then the point at which the true pattern and the spurious pattern have equal contrast should be taken as the true resolution.

1.3.2.2.2 Side Panels

Perform the following procedure if the proponent system includes transmission of side panel information in a manner different from transmission of picture center information.

Pan the test pattern slowly to the left, pausing frequently to observe the resolution of the pattern in the leftmost one-eighth of the picture width. Position the pattern such that the point of limiting vertical resolution is within this side-panel area. Using the calibration circles, estimate the spatial frequency, in C/PH, at which the radials become visible or at which the true radial pattern and any spurious pattern have equal contrast.

As a confirmation of this measurement, pan the test pattern to the right, and find the limiting vertical resolution in the rightmost one-eighth of the picture width.

Upon completion of this procedure, return the test pattern to the centered position.

1.3.2.3 Presentation of Data

The following data should be recorded:

From the picture monitor, the limiting vertical resolution of the center area, and of the side panels, in C/PH.

Obtain photographs of the picture monitor, for each position of the test pattern at which a measurement is taken, using a video gate time of one frame.

Make a 15-second recording on the HD DVTR, at each test pattern position, and note the SMPTE time code at the start of each recording.

1.3.3 Luminance Static Diagonal Resolution - ATV System

1.3.3.1 Setup

The setup described in Section 1.3.1.1 can remain in place for this measurement, although the waveform monitor is not used.

1.3.3.2 Measurement Technique

1.3.3.2.1 Center Area

Observe the picture monitor, and discern the limiting diagonal resolution. Look in the four corner quadrants of the pattern, and note the points at which the individual diagonal radials emerge from the gray background. The points of limiting resolution may not lie along 45-degree diagonals, but should be found symmetrically positioned with respect to the horizontal and vertical axes through the center of the pattern. Using the calibration circles, estimate the spatial frequency, in C/PH, at which the radials become visible. Record the lowest frequency at which limiting resolution is observed diagonally.

1.3.3.2.2 Side Panels

Perform the following procedure if the proponent system includes transmission of side panel information in a manner different from transmission of picture center information.

Shift the PIXAR pattern horizontally and vertically to determine the point of limiting diagonal resolution in the side-panel area, the leftmost or rightmost one-eighth of the picture width. If available, use the H Delay or Pulse Cross mode of the picture monitor. Record the lowest frequency at which limiting resolution is observed diagonally.

Upon completion of this procedure, return the test pattern to the centered position.

1.3.3.3 Presentation of Data

The following data should be recorded:

From the picture monitor, the limiting diagonal resolution of the center area, and of the side panels, in C/PH.

Obtain photographs of the picture monitor, for each position of the test pattern at which a measurement is taken, using a video gate time of one frame.

Make a 15-second recording on the HD DVTR, at each test pattern position, and note the SMPTE time code at the start of each recording.

1.3.4 Luminance Static Horizontal Resolution - NTSC Receiver Output

1.3.4.1 Setup

The output of the PIXAR remains connected to the Red, Green, and Blue inputs of the SUT, as configured in Section 1.3.1.1.

Connect the output of the reference NTSC demodulator to the waveform monitor. Connect the "picture monitor output" of the waveform monitor to the picture monitor. Terminate each cable in 75 ohms.

Select PIXAR Test Pattern No. 1. It contains a radial resolution pattern, calibrated from 100 to 500 C/PH in the NTSC compatible image area.

1.3.4.2 Measurement Technique

Observe the picture monitor, and discern the limiting horizontal resolution. Look up and down along a vertical axis through the center of the pattern, and note the points above and below the center at which the individual radials emerge from the gray background. Using the calibration circles, estimate the spatial frequency, in C/PH, at which the radials become visible.

Using the line selector of the waveform monitor, move the cursor so that it is tangent to a point of limiting resolution noted above. The amplitude of the observed sinusoidal waveform should diminish to nearly zero at the center of this line.

Note the peak-to-peak amplitude of the radial resolution pattern, in the lowest-frequency portion of the pattern. This is the reference amplitude for the resolution response measurement.

Move the line selector toward the top or bottom of the pattern to find the line corresponding to the half-amplitude resolution response. At the center of the correct line, the amplitude of the sinusoid should be one-half of the reference amplitude noted above. Observe the position of the line-select cursor overlaid on the picture display. Using the calibration circles, estimate the spatial frequency, in C/PH, at which the cursor intersects the vertical center axis of the pattern.

1.3.4.3 Presentation of Data

The following data should be recorded:

From the picture monitor, the limiting horizontal resolution in C/PH.

From the waveform monitor, the half-amplitude resolution response in C/PH.

For reference purposes, record the selected line numbers on which the limiting resolution, reference amplitude, and half amplitude were observed on the waveform monitor.

Photograph the picture monitor, using a video gate time of one frame. Also photograph the waveform monitor displays of the selected lines.

Make a 15-second recording on the NTSC DVTR, and note the SMPTE time code at the start of the recording.

1.3.5 Luminance Static Vertical Resolution - NTSC Receiver Output

1.3.5.1 Setup

The setup described above, in Section 1.3.4.1, can remain in place for this measurement, although the waveform monitor is not used.

1.3.5.2 Measurement Technique

The technique to be used for this measurement is identical to that described in Section 1.3.2.2.1 for the center area of an ATV image.

1.3.5.3 Presentation of Data

The following data should be recorded:

From the picture monitor, the limiting vertical resolution in C/PH.

Photograph the picture monitor using a video gate time of one frame.

Make a 15-second recording on the NTSC DVTR, and note the SMPTE time code at the start of the recording.

1.3.6 Luminance Static Diagonal Resolution - NTSC Receiver Output

1.3.6.1 Setup

The setup described in Section 1.3.4.1 can remain in place for this measurement, although the waveform monitor is not used.

1.3.6.2 Measurement Technique

The technique to be used for this measurement is identical to that described in Section 1.3.3.2.1 for the center area of an ATV image.

1.3.6.3 Presentation of Data

The following data should be recorded:

From the picture monitor, the limiting diagonal resolution in C/PH.

Photograph the picture monitor using a video gate time of one frame.

Make a 15-second recording on the NTSC DVTR, and note the SMPTE time code at the start of the recording.

1.3.7 Luminance Dynamic Horizontal Resolution - ATV System

The procedure released for comment in the September 14, 1989, revision of this document has been withdrawn in order to not impede approval of the balance of the document. Strong reservations were expressed by some proponents concerning the validity of all dynamic resolution measurement procedures. A scientifically valid method that is also practical to implement by ATTC is currently under study.

1.3.8 Luminance Dynamic Vertical Resolution - ATV System

The previously released dynamic resolution measurement procedure has been withdrawn. (See Section 1.3.7.) An alternative procedure is under study.

1.3.9 Luminance Dynamic Diagonal Resolution - ATV System

The previously released dynamic resolution measurement procedure has been withdrawn. (See Section 1.3.7.) An alternative procedure is under study.

1.3.10 Luminance Dynamic Horizontal Resolution - NTSC Receiver Output

The previously released dynamic resolution measurement procedure has been withdrawn. (See Section 1.3.7.) An alternative procedure is under study.

1.3.11 Luminance Dynamic Vertical Resolution - NTSC Receiver Output

The previously released dynamic resolution measurement procedure has been withdrawn. (See Section 1.3.7.) An alternative procedure is under study.

1.3.12 Luminance Dynamic Diagonal Resolution - NTSC Receiver Output

The previously released dynamic resolution measurement procedure has been withdrawn. (See Section 1.3.7.) An alternative procedure is under study.

1.3.13 Chrominance Static Horizontal Resolution - ATV System

1.3.13.1 Setup

Two setups are required for measuring this parameter, and the complete procedure must be executed twice -- once for each setup.

For all measurements, connect the Red, Green, and Blue outputs of the PIXAR to the respective inputs of the SUT.

For the first set of measurements, connect the Red output of the SUT to the waveform monitor. Terminate the cable in 75 ohms. Using matrix coefficients supplied by the proponent, set the amplitudes of the PIXAR outputs such that only the "R-Y" (or "I") color-difference channel of the SUT is modulated with an AC waveform, and the "B-Y" (or "Q") and luminance channels have a constant-amplitude signal over the entire area of the test pattern.

For the second set of measurements, connect the Blue output of the SUT to the waveform monitor. Terminate the cable in 75 ohms. Using matrix coefficients supplied by the proponent, set the amplitudes of the PIXAR outputs such that only the "B-Y" (or "Q") color-difference channel of the SUT is modulated with an AC waveform, and the "R-Y" (or "I") and luminance channels have a constant-amplitude signal over the entire area of the test pattern.

The "picture monitor output" of the waveform monitor remains connected to the picture monitor for all measurements.

It is anticipated that there will be a wide variation in chrominance static horizontal resolution among the proposed systems, since this is a parameter that is subject to various trade-offs. Values of limiting resolution may be found to range from approximately 15 C/PH (equivalent to the NTSC "Q" channel bandwidth) to approximately 350 C/PH, for an RGB system that does not compromise chrominance with respect to luminance resolution. Since a single radial resolution pattern has a useful range of about two octaves of horizontal spatial frequency, three patterns are required to cover the anticipated range for this parameter.

PIXAR Test Pattern No. 1 contains a radial resolution pattern, calibrated from 100 to 500 C/PH in the center NTSC compatible image area, continuing into each side panel area.

PIXAR Test Pattern No. 2 contains a radial resolution pattern, calibrated from 50 to 250 C/PH in the center NTSC compatible image area, continuing into each side panel area.

PIXAR Test Pattern No. 3 contains a radial resolution pattern, calibrated from 10 to 50 C/PH in the center NTSC compatible image area, continuing into each side panel area.

Select the appropriate test pattern for each measurement, based upon the resolution claimed by the proponent. During the procedure, it may be necessary to change patterns if the measured resolution is outside the range of the initially selected pattern. Verify whether the proponent system transmits side panels that must be evaluated separately from the center image area. Also determine, from data supplied by the proponent, the number of frames necessary to capture photographically all of the chrominance information.

1.3.13.2 Measurement Technique

The technique for making these measurements is identical to that described in Section 1.3.1.2 for Luminance Static Horizontal Resolution - ATV System.

1.3.13.3 Presentation of Data

The following data should be recorded for each set of measurements, Red and Blue:

From the picture monitor, the limiting horizontal resolution of the center area, and of the side panels, in C/PH.

From the waveform monitor, the half-amplitude resolution response of the center area, and of the side panels, in C/PH.

For reference purposes, record the selected line numbers on which the limiting resolution, reference amplitude, and half amplitude, for the center area and the side panels, were observed on the waveform monitor.

Photograph the picture monitor, using the video gate time specified by the proponent. Also photograph the waveform monitor displays of the selected lines.

Make a 15-second recording on the HD DVTR, for each position of the test pattern at which a measurement is taken, and note the SMPTE time code at the start of each recording.

1.3.14 Chrominance Static Vertical Resolution - ATV System

1.3.14.1 Setup

Two setups are required for measuring this parameter, and the complete procedure must be executed twice -- once for each setup. These setups are identical to those described above, in Section 1.3.13.1, except that the waveform monitor is not used but may remain connected.

Choosing among PIXAR Test Patterns 1, 2, and 3, as described in Section 1.3.13.1, select the appropriate pattern for each measurement, based upon the vertical resolution claimed by the proponent. During the procedure, it